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In the Siphonophora, then, the reduction of a colony of budded individuals to the condition of a single composite individual has greatly progressed, so far as indications go. Their embryological development points to such an origin. In fact, the Hydrozoa generally are born from the egg as ciliated planulæ, which, after a period of free-swimming existence, become fixed and develop the mouth and tentacles of the Hydroid type. Only later the polyp buds sprout and the polypary is formed. Thus their embryological development indicates the character of their phylogenetic evolution.

(To be continued.)

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REVIEW OF THE PROGRESS OF NORTH AMERICAN BATRACHOLOGY IN THE YEARS 1880-1883.

BY W. N. LOCKINGTON.

IN this department little has been done in the direction of descriptive zoölogy—probably little remains to be done in the limits of the United States, while the researches of Sumichrast Bocourt, Cope and others, must have nearly exhausted the riches of Mexico and Central America in batrachian forms. Fortunately the batrachia are still, as they have been, favorite subjects with the anatomist and embryologist, and to this fact we owe much of the material presented in this article.

The most important addition to North American Batrachology within the two years to which we are confined is certainly that of M. Brocchi, forming one of the quarto numbers of the magnificent work which for several years has been published under the direction of M. H. Milne Edwards, by order of the Minister of Public Instruction, and entitled "*Mission Scientifique au Mexique et dans l'Amerique Centrale.*" The part already published, though containing only the Raniformia and a portion of the Hylæformia, comprises descriptions of seventy species, eleven of which are new. The classification adopted is unfortunately that of Dumeril and Bibron. The primary division of the Anura is into Phaneroglossa and Aglossa. The former group is divided into Hylæformia, Raniformia, Hemiphractiformia (having teeth in both jaws), Bufoniformia and Hylapesiformia, the last section containing forms which are toothless like the toads, but are without the dilated sacral vertebræ of the latter. The Aglossa are

divided into Dactylethriformia and Pipæformia, the latter without teeth in the upper jaw.

The classifications of Günther, Mivart and Cope are reviewed, the character separating the Bufoniformia from the Hylapesiformia, and that dividing the Aglossa, are taken from Mivart, while the reasons given for the rejection of Cope's views are: 1st, the difficulty that arises, in practice, when a valuable specimen can only be correctly placed by its destruction in the search for characters drawn from its osteology; 2d, the length of time necessary for the complete ossification of the batrachian skeleton, so that, unless the specimen is adult, it cannot always be determined to which section it rightly belongs.

The first of these objections is well answered by Mr. G. A. Boulenger, in the introduction to the catalogue of Batrachia Salientia in the British Museum, already noticed by us in Vol. xvii, p. 181. In adopting Professor Cope's system, Mr. Boulenger says, "Very little skill is required to obtain the necessary information without serious injury to the specimen. Herpetologists have long been in the habit of making an incision in the skin of the pelvic region for the purpose of ascertaining whether the diapophyses of the sacral vertebræ are dilated or not; a slit made in the same manner along the thorax will show the sternal characters, and another (which can be sewn up again) along the side of the body, will suffice for the examination of the structure of the vertebral column."

M. Brocchi's volume is illustrated by ten well executed colored plates, in which the external and craniological characters of the newly described species are shown.

Among the new forms are *Rana vaillantii*, *Rana macroglossa*, *R. maculata*, *Leptodactylus fragilis*, *Hyla plicata*, *H. pænulata*, *H. crassa* and *H. guatemalensis*. For the latter the new name, *Camphias* is proposed, but this is a synonym of the *Hypsiboas* of Wagler, as defined by Cope. There are some other synonyms among the Bufones and Hylæ.

Among the species described from Mexico the following occur also in the United States, according to Brocclin, *Rana halecina* L., *Scaphiopus solitarius* Holbrook, *Hyla regilla* Baird and Girard (Oregon, California), *Hyla versicolor* Harlan, *Hyla verrucosa* (Florida) and *Hyla cadaverina* Cope (Pacific Region).

Miss M. H. Hinckley (Proc. Bost. Soc. Nat. Hist., 1880) details

her observations upon the metamorphoses of *Hyla versicolor*. Eggs laid May 10th become frogs on July 4th. In two days after deposition all the ova were hatched, in four days the external gills were developed, in eight days the external gills were completely resorbed on both sides; and in seventeen days after deposition the hind legs commenced to bud, but the fore-legs did not both become free until about July 3d, by which time the edges of the tail were undergoing resorption. The tail in some cases disappeared in thirty-six hours.

Miss Hinckley also describes and figures (Proc. Bost. Soc. Nat. Hist., 1882, pp. 307-315) some differences in the mouth structure of the anurous batrachia of Massachusetts. These fall into three groups, which characterize the frogs, tree-frogs and toads. In the first the upper lip is shorter and narrower than in the others, and a papillose border, bending inwards at the angles of the mouth extends around the lower lip and overlaps the upper slightly on both sides.

In the tree-frog tadpoles observed (*Hyla versicolor* and *Hyla pickeringii*) the upper lip is broad and falls into two deep curves, along the lateral portions of which extend papillæ like those of the lower lip. The papillæ are small, and the papillose border does not bend inwards at the mouth angles. In the toads, *Bufo americanus* and *B. fowleri*, the upper lip is broad and nearly straight, and the lower lip is fringed and without papillæ in the center.

The upper lips in all the species, the under lips when not edged with papillæ, and several fleshy folds which extend across both lips, especially the lower, are fringed with what appear in the microscope to be closely set teeth of uneven length. These fringes serve to collect and hold the food, both upper and under lips being used for this purpose; and Miss Hinckley observes that animal food appears to be preferred to vegetable by young tadpoles. *Rana sylvatica* has four fringed folds on the lower lip, while the other Ranidæ observed have three. *Hyla versicolor* has three fringed folds on the lower lip, while *Hyla pickeringii* has but two, and a short space of fringe on the margin of the lip. The same observer has also some notes on the development of *Rana sylvatica* which in many respects appears to be very distinct from other New England Ranidæ. It congregates earliest in spring for the business of oviposition, but cannot move in water below 45°F.

As many as 1380 eggs are contained in a single mass. The time in which the eggs develop varies greatly according to temperature. The metamorphosis of the tadpoles observed occupied from April 12 to June 9th, when the tail had wholly disappeared, and tadpoles which on May 31st measured 58^{mm} in length were reduced to young frogs 18^{mm} long. The external gills became fully developed two days after hatching, and in four days more were entirely resorbed, leaving an opening through which the action of the internal gills could be seen. The legs budded on May 6th, and by May 20 the feet and toes were well defined.

In the *Canadian Naturalist* (Vol. 9, p. 160), Mr. H. Montgomery observes that examples of *Menobranchus* kept in an aquarium plentifully stocked with mollusks fed entirely upon fishes.

Mr. W. Frear, in a note to the *AMERICAN NATURALIST*, gives a curious instance of the vitality of this batrachian. An individual that had lain exposed to the summer sun for forty-eight hours, and had been completely covered with alcohol for twenty hours gave undoubted signs of vitality, by opening its mouth and swaying its tail, when placed on the dissecting table.

Mr. J. S. Kingsley (Proc. Bost. Soc., 1881) notices a case of polymely, or the development of an additional limb, in an example of *Rana halecina*. The supernumary limb, is in origin and structure a limb of the left side, but occupies nearly the position of a tail. The myology of the proximal part of this extra leg is far less perfect than that of the distal, but the most singular abnormality is the formation of an acetabulum for the odd limb at the symphysis of the pubes.

Wm. E. Carlin (Proc. U. S. Nat. Mus. 1881) states that large numbers of the *Siredon lichenoides* of Como Lake change every season to the *Amblystoma* state, but that the change takes place much more slowly in the alkaline waters of the lake than in fresh water.

S. F. Clarke (Johns Hopkins University, Studies from the Biological Laboratory) gives the result of observations upon the development of *Amblystoma punctatum*. The eggs are deposited in masses of from two to three hundred, each covered with a tenacious gelatinous coating, at first thin, but rapidly becoming thick by absorption of water. Thus each egg consists of two membranous shells, separated by a space filled with clear fluid, and is well protected from voracious fishes. In the act of depositing

the ova, the female lies with her anterior limbs extended laterally, and her hind limbs curved round the opening of the cloaca, apparently to assist in holding the eggs together. If disturbed she leaves the spot, and commences the operation elsewhere. The male deposits the spermatic liquid upon the eggs. The spermatozoa are very large, .75 millimetre in length, while those of *Menopoma* are only .25^{mm} and those of *Rana temporaria* .008^{mm}. They are long slender filaments, pointed at both ends. The ova, as usual in Batrachia, have a light and dark-colored pole, but the dark portion, instead of being much smaller than the light one, as is frequent, is equal to it in size, so that the third segmentation furrow is equatorial. After this furrow is formed segmentation proceeds most rapidly at the light colored pole, which is always the lowest, and the dark area increases until the only light part left is a small area around the lower pole, and extending upward from on one side. This white area then becomes surrounded by a furrow, and forms a prominence, the "vitelline plug" of Ecker. Gradually the vitelline plug sinks into the mass of the egg, except a very small round spot, from which extend outwardly the rudimentary walls of the medullary folds. By the end of the fourth day these folds have spread anteriorly to the cephalic end, and the egg has now become elongated in the direction of the medullary folds and their central groove. In about nine hours more the neural tube is enclosed, by this time the embryo has much increased in size and weight, and the entire surface is covered with cilia. A constriction next defines the head, and the optic lobes appear as oval prominences. The throat is next marked off, the proto-vertebræ appear, branchial lobes are developed, and the anterior limbs indicated. The tail lengthens, and the balancers, so-called from their resemblance to the balancers of dipterous insects, appear between the eyes and branchial lobes. Active muscular movements next occur, the gills are defined, the pulsations of the heart are visible, and pigment cells are produced. Most of the energy is now devoted to the growth of the gills and balancers, and at the next stage the caudal and dorsal fins grow actively. The balancers, held out so that they point outwards and downwards, aid in keeping the head and branchiæ free from the dirt at the bottom; they decrease as the anterior limbs increase, and finally break off, about twenty-eight days after the vitelline plug was formed. With the appearance of the third digit of the anterior limbs the lobes that will form the hind-

limbs commence to bud. At the age of sixty days all the external parts are formed, and it undergoes no external change except growth until the branchiæ are resorbed, a process which occupies from three to five days. The entire series of changes, in vigorous examples, occupies about a hundred days.

The same writer gives an account of the development of the Wolffian body in this salamander. It arises from the outer layer of the mesoderm as a solid rod of cells, and is at first largest anteriorly, a dorsal and ventral duct are then formed by the splitting of the cells, and an opening into the body cavity is made from the dorsal duct. The method of development of this organ differs from that observed in allied forms that have been worked out, and is most like that of the Elasmobranchiates.

The same laboratory furnishes some interesting notes upon the secretion of the pepsin-forming glands of the frog, by H. F. Sewall. The œsophageal glands, which, when the intestinal canal is empty, are full of fine granules, undergo marked changes in digestion, losing the greater part of these granules during the process. These changes are started by the mere absorption of matter from the alimentary canal, but the regeneration of the glands depends upon the presence of new matter in the blood itself.

The fifth Bulletin of the Illinois State Laboratory of Natural History is a list of the Batrachia and Reptilia found east of the Mississippi, by N. S. Davis and F. L. Rice. *Siren lacertina* is credited to Northeastern Illinois. The Bulletin No. of the U. S. National Museum consists of a check-list of the Reptilia and Batrachia of North America. The classification is based on that of Professor Cope, as set forth in Bulletin No. 1, of the same series.

The work of Dr. J. J. Mason, upon the minute structure of the central nervous system of certain reptiles and batrachians is a valuable addition to our knowledge of brain-structure in the latter, illustrated as it is by artotype plates taken from negatives made by the author. Numerous sections of the spinal cord and brain of *Rana*, *Menopoma*, *Diemyctylus* and *Siren* are given. The transversely-developed spinal cord of *Menopoma*, deeply fissured posteriorly, contrasts greatly with the oval and slightly fissured form of that of *Rana*. The writer does not claim to distinguish between motor and sensory cells, and considers that the theory which makes the nuclei the true function centres of the nerve-cells, is an unproved one.